

# EXHIBIT M



v00.0805



# HMC344LH5

## GaAs MMIC SP4T NON-REFLECTIVE SWITCH, DC - 12 GHz

### Typical Applications

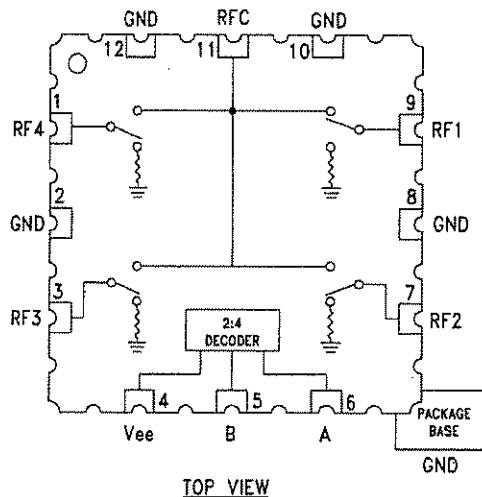
This switch is suitable for DC - 12.0 GHz 50-Ohm Systems

- Telecom Infrastructure
- Military Radio, Radar & ECM
- Space Systems
- Test Instrumentation

### Features

- Broadband Performance: DC - 12 GHz
- High Isolation: 42 dB@ 6 GHz
- Low Insertion Loss: 1.8 dB@ 6 GHz
- Integrated 2:4 TTL Decoder
- Hermetic SMT Package, 25 mm<sup>2</sup>
- Screening to MIL-PRF-38535 (Class B or S) Available

### Functional Diagram



TOP VIEW

### General Description

The HMC344LH5 is a broadband non-reflective GaAs MESFET SP4T switch in a hermetic SMT leadless package. Covering DC to 12 GHz, this switch offers high isolation and low insertion loss. This switch also includes an on board binary decoder circuit which reduces the required logic control lines to two. The switch operates using a negative control voltage of 0/-5V, and requires a fixed bias of -5V. Simple external level shifting circuitry allows this switch to be controlled with most TTL/CMOS positive logic families. The HMC344LH5 allows the use of surface mount manufacturing techniques and is suitable for high reliability military, industrial and space applications.

### Electrical Specifications, $T_A = +25^\circ \text{C}$ , With Vee = -5V & 0/-5V Control, 50 Ohm System

Parameter	Frequency	Min.	Typ.	Max.	Units
Insertion Loss	DC - 2.0 GHz		1.5	1.9	dB
	DC - 6.0 GHz		1.8	2.2	dB
	DC - 8.0 GHz		2.1	2.5	dB
	DC - 12.0 GHz		3.0	3.4	dB
Isolation	DC - 2.0 GHz	48	53		dB
	DC - 4.0 GHz	43	48		dB
	DC - 6.0 GHz	37	42		dB
	DC - 8.0 GHz	35	40		dB
	DC - 12.0 GHz	30	35		dB
Return Loss	"On State"	DC - 10.0 GHz	17		dB
		DC - 12.0 GHz	12		dB
Return Loss	"Off State"	DC - 8.0 GHz	16		dB
		DC - 12.0 GHz	10		dB
Input Power for 1 dB Compression	0.5 - 12.0 GHz	24	27		dBm
Input Third Order Intercept (Two-Tone Input Power = +7 dBm Each Tone)	0.5 - 4.0 GHz		50		dBm
	4.0 - 8.0 GHz		47		dBm
	8.0 - 12.0 GHz		44		dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)	DC - 12.0 GHz		35		ns
			75		ns

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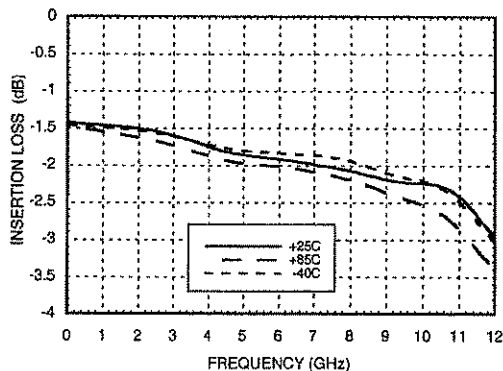
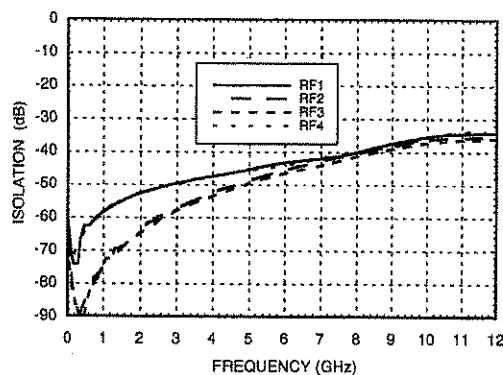
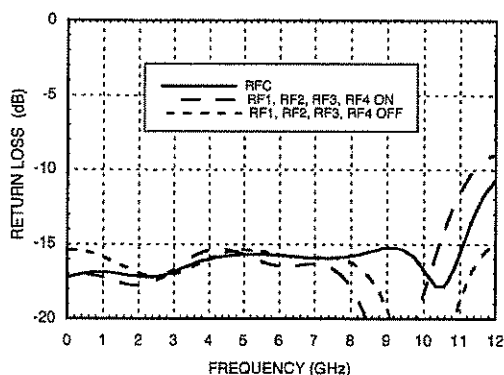
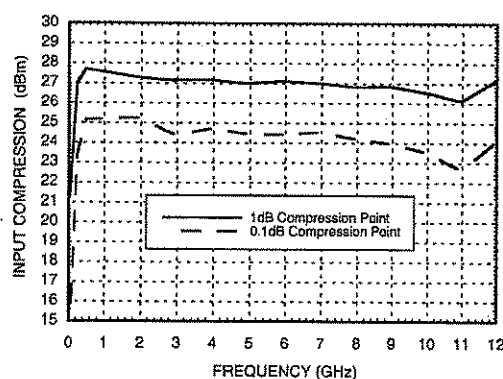
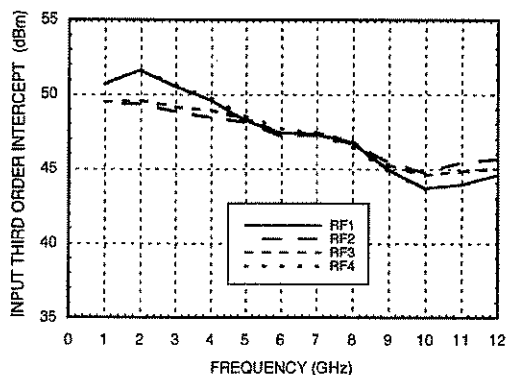
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**HMC344LH5****GaAs MMIC SP4T NON-REFLECTIVE  
SWITCH, DC - 12 GHz****Insertion Loss vs. Temperature****Isolation****Return Loss****0.1 and 1 dB Input Compression Point****Input Third Order Intercept Point****Bias Voltage & Current**

V <sub>ee</sub> Range = -5.0 Vdc ± 10%		
V <sub>ee</sub> (Vdc)	I <sub>ee</sub> (Typ.) (mA)	I <sub>ee</sub> (Max.) (mA)
-5.0	3.0	6.0

**Control Voltages**

State	Bias Condition
Low	-3V to 0 Vdc @ 40 uA Typical
High	-5 to -4.2 Vdc @ 5 uA Typical

\* Isolation is recorded above insertion loss & measured at output of switch.

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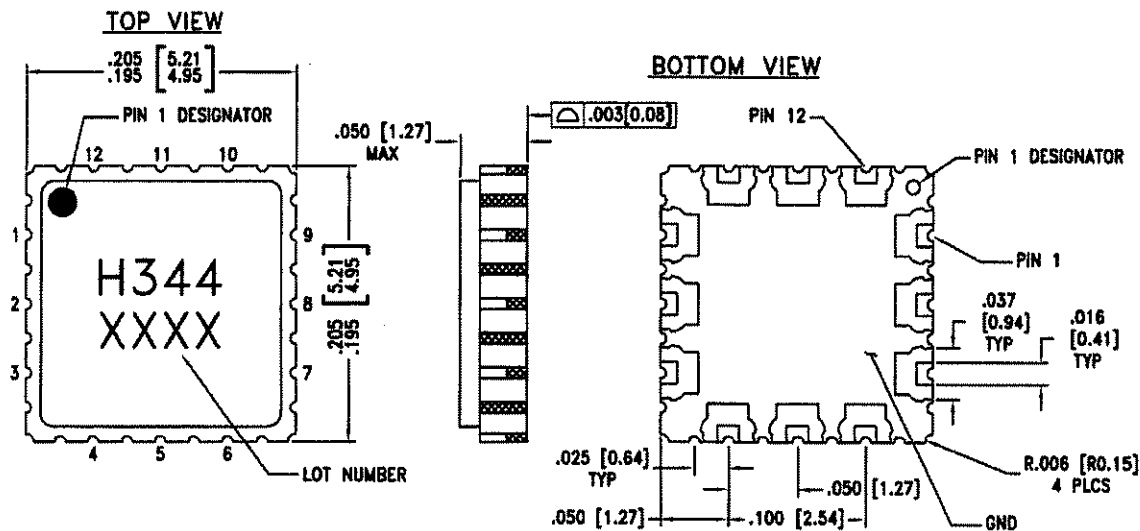
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**HMC344LH5****GaAs MMIC SP4T NON-REFLECTIVE  
SWITCH, DC - 12 GHz****Absolute Maximum Ratings**

Bias Voltage Range (V <sub>ee</sub> )	-7.0 Vdc
Control Voltage Range (A & B)	V <sub>ee</sub> -0.5V to +1.0 Vdc
Channel Temperature	150 °C
Thermal Resistance (Insertion Loss Path)	157 °C/W
Continuous P <sub>diss</sub> (T = 85 °C) (derate 6.4 mW/°C above 85 °C)	0.42 W
Thermal Resistance (Terminated Path)	264 °C/W
Continuous P <sub>diss</sub> (T = 85 °C) (derate 3.8 mW/°C above 85 °C)	0.25 W
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
Maximum Input Power	+28 dBm (0.5 - 12.0 GHz)
ESD Sensitivity (HBM)	Class 1A

**Truth Table**

Control Input		Signal Path State
A	B	RFC to:
High	High	RF1
Low	High	RF2
High	Low	RF3
Low	Low	RF4

**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS****Outline Drawing****NOTES:**

1. PACKAGE BODY MATERIAL: CERAMIC & KOVAR
2. LEAD AND GROUND PADDLE PLATING: GOLD 40 - 80 MICROINCHES.
3. DIMENSIONS ARE IN INCHES (MILLIMETERS).
4. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
5. PAD BURR LENGTH 0.15mm MAX.  
PAD BURR HEIGHT 0.25mm MAX.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.

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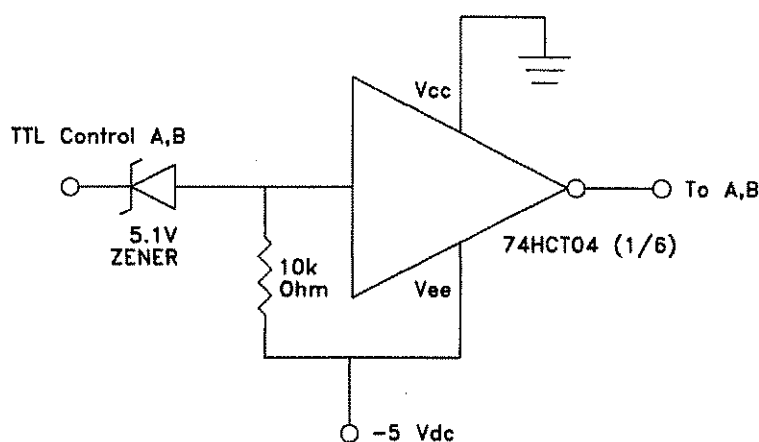


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**HMC344LH5****GaAs MMIC SP4T NON-REFLECTIVE  
SWITCH, DC - 12 GHz****Pin Descriptions**

Pin Number	Function	Description	Interface Schematic
1, 3, 7, 9, 11	RF4, RF3, RF2, RF1, RFC	This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required if RF line potential is not equal to 0V.	
2, 8, 10, 12	GND	Package base must also be connected to PCB RF ground.	
4	Vee	Supply Voltage -5V $\pm$ 10%	
5	B	See truth table and control voltage table.	
6	A	See truth table and control voltage table.	

**TTL Interface Circuit**

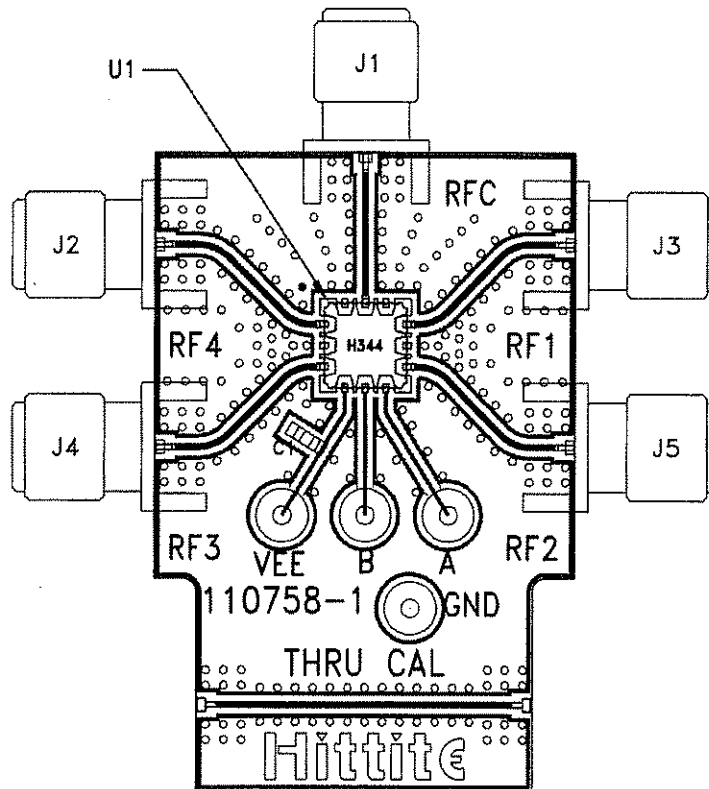
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**HMC344LH5****GaAs MMIC SP4T NON-REFLECTIVE  
SWITCH, DC - 12 GHz****Evaluation PCB****List of Materials for Evaluation PCB 110760 [1]**

Item	Description
J1 - J5	PCB Mount SMA RF Connector
J6 - J9	DC Pin
C1	10k pF Capacitor, 0603 Pkg.
U1	HMC344LH5 SP4T Switch
PCB [2]	110768 Evaluation PCB

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the final application should be generated with proper RF circuit design techniques. Signal lines at the RF port should have 50 ohm impedance and the package ground leads and package base should be connected directly to the ground plane similar to that shown above. The evaluation circuit board shown above is available from Hittite Microwave Corporation upon request.

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**HMC344LH5****GaAs MMIC SP4T NON-REFLECTIVE  
SWITCH, DC - 12 GHz****Notes:**

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